US009184358B2

(12) **United States Patent**
Jang et al.

(10) **Patent No.: US 9,184,358 B2**
(45) **Date of Patent: Nov. 10, 2015**

(54) **LEAD FRAME AND LIGHT EMITTING DIODE PACKAGE HAVING THE SAME**

(71) Applicant: **ADVANCED OPTOELECTRONIC TECHNOLOGY, INC.**, Hsinchu Hsien (TW)

(72) Inventors: **Yau-Tzu Jang**, Hsinchu (TW); **Yu-Liang Huang**, Hsinchu (TW); **Wen-Liang Tseng**, Hsinchu (TW); **Pin-Chuan Chen**, Hsinchu (TW); **Lung-Hsin Chen**, Hsinchu (TW); **Hsing-Fen Lo**, Hsinchu (TW); **Chao-Hsiung Chang**, Hsinchu (TW); **Che-Hsang Huang**, Hsinchu (TW); **Yu-Lun Hsieh**, Hsinchu (TW)

(73) Assignee: **ADVANCED OPTOELECTRONIC TECHNOLOGY, INC.**, Hsinchu Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 11 days.

(21) Appl. No.: **14/059,463**

(22) Filed: **Oct. 22, 2013**

(65) **Prior Publication Data**

US 2014/0167078 A1 Jun. 19, 2014

(30) **Foreign Application Priority Data**

Dec. 18, 2012 (CN) 2012 1 05511023

(51) **Int. Cl.**
H01L 33/62 (2010.01)
H01L 25/075 (2006.01)
H01L 33/60 (2010.01)

(52) **U.S. Cl.**
CPC ***H01L 33/62*** (2013.01); ***H01L 25/0753*** (2013.01); *H01L 33/60* (2013.01); *H01L 2224/48137* (2013.01)

(58) **Field of Classification Search**
CPC H01L 33/62; H01L 25/0753; H01L 2224/48137
USPC 257/88
See application file for complete search history.

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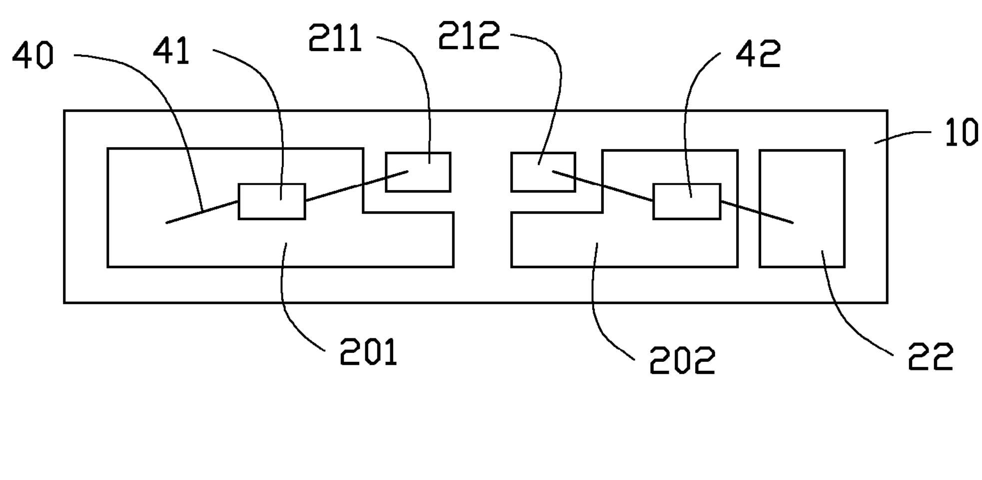
Primary Examiner — Steven Loke
Assistant Examiner — Arash Majdi
(74) *Attorney, Agent, or Firm* — Novak Druce Connolly Bove + Quigg LLP

(57) **ABSTRACT**

An exemplary lead frame includes a substrate and a bonding electrode, a first connecting electrode, and a second connecting electrode embedded in the substrate. A top surface of the bonding electrode includes a first bonding surface and a second bonding surface spaced from the first bonding surface. A top surface of the first connecting electrode includes a first connecting surface and a second connecting surface spaced from the first connecting surface. Top surfaces of the bonding electrode, the first connecting electrode and the second connecting electrode are exposed out of the substrate to support and electrically connect with light emitting chips. Light emitting chips can be mounted on the lead frame and electrically connect with each other in parallel or in series; thus, the light emitting chips can be connected with each in a versatile way.

12 Claims, 12 Drawing Sheets



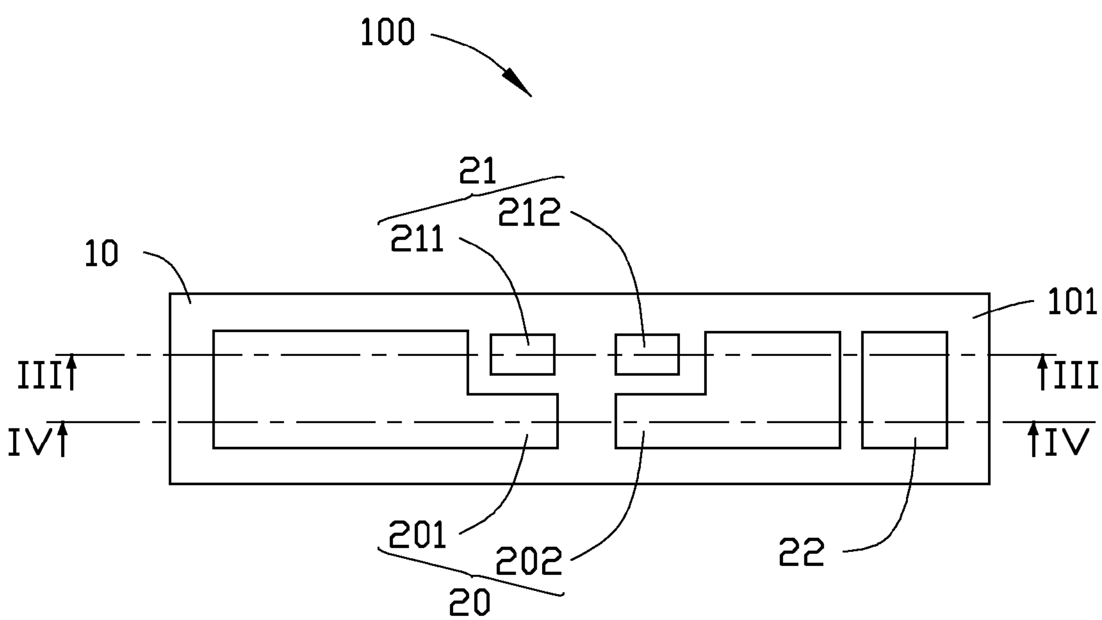


FIG. 1

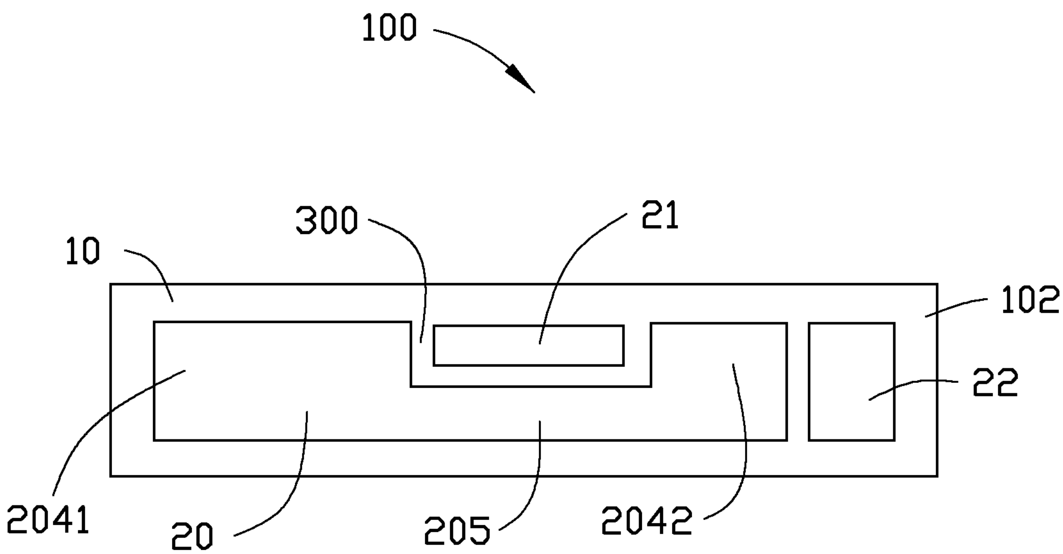


FIG. 2

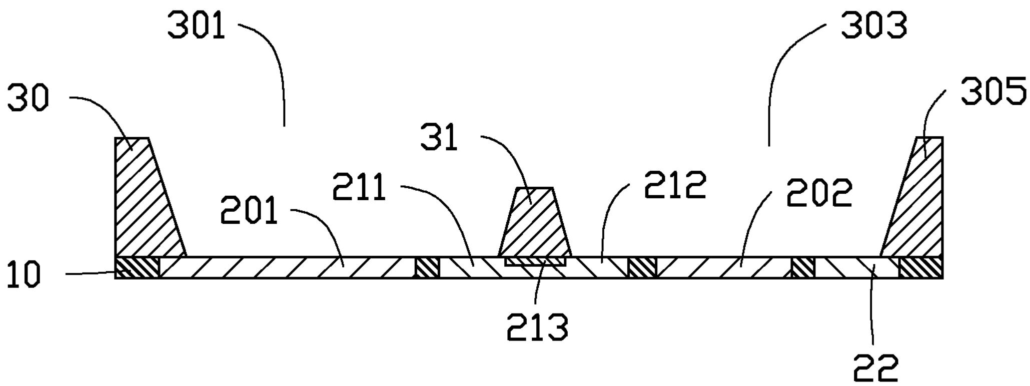


FIG. 3

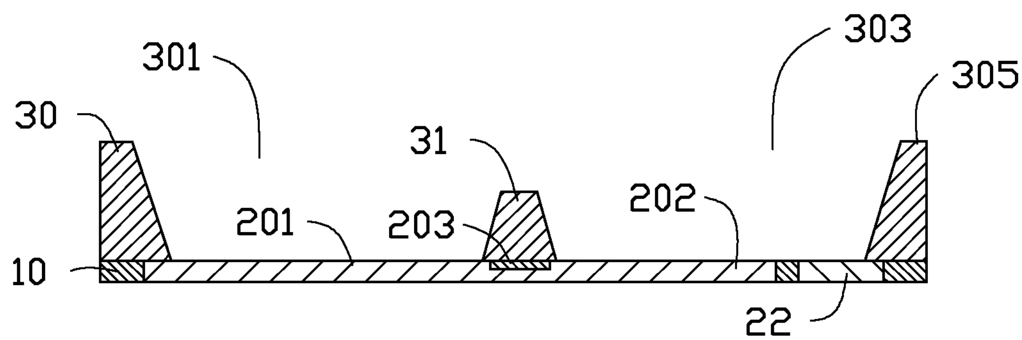


FIG. 4

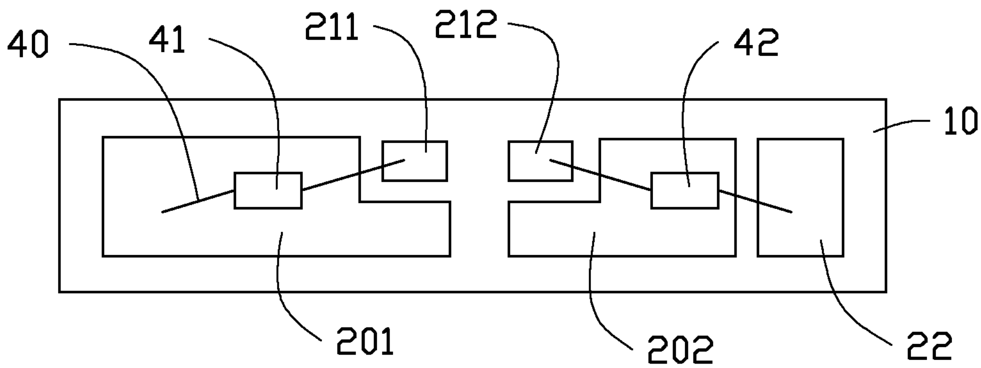


FIG. 5

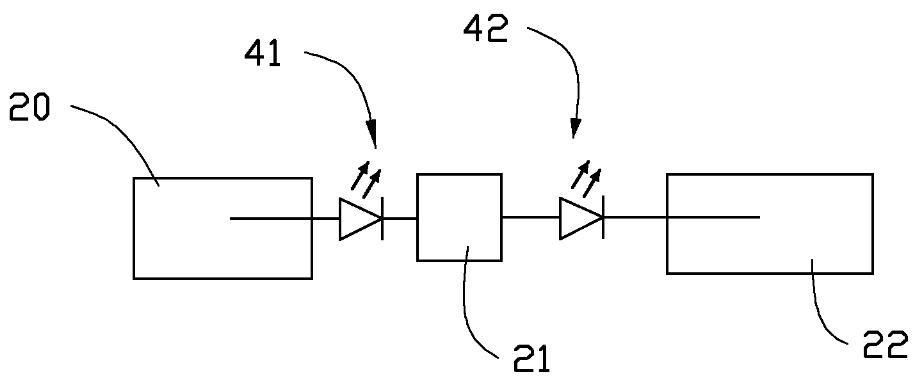


FIG. 6

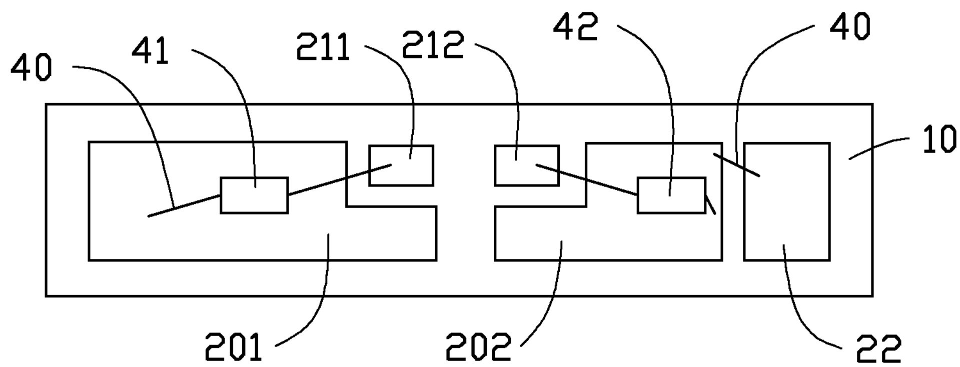


FIG. 7

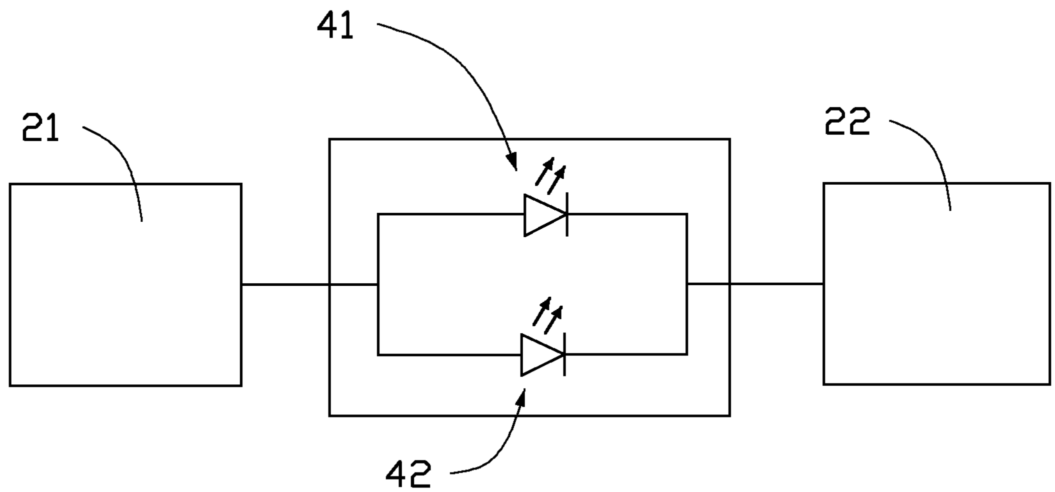


FIG. 8

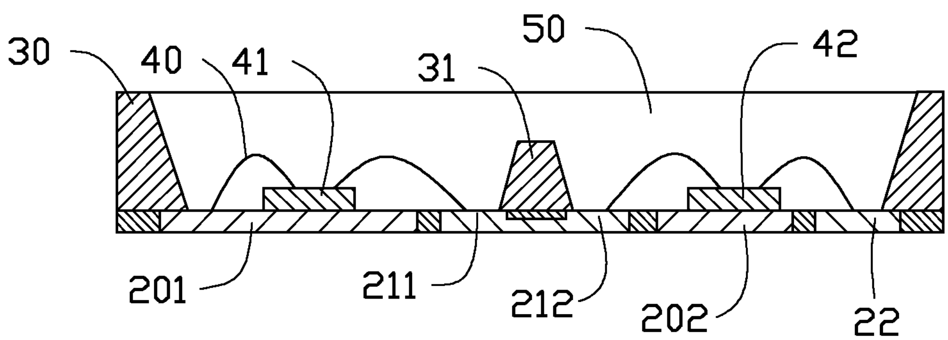


FIG. 9

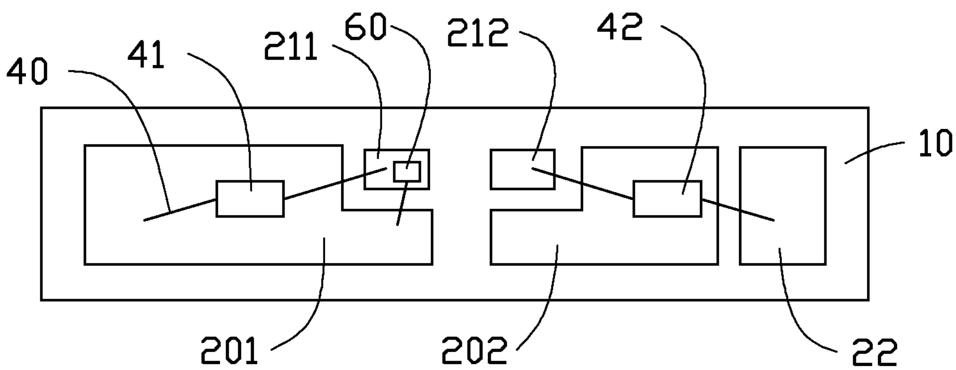


FIG. 10

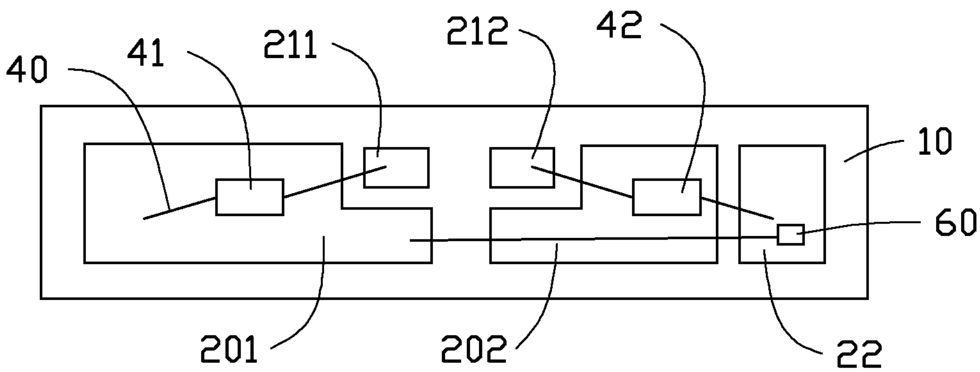


FIG. 11

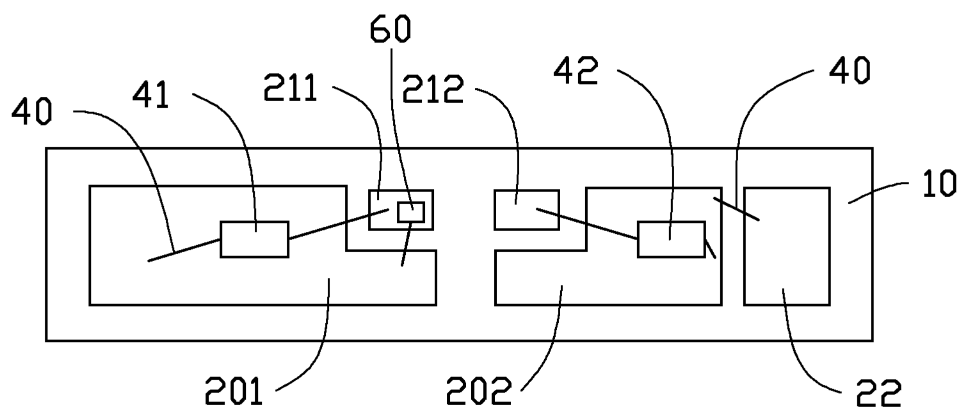


FIG. 12

LEAD FRAME AND LIGHT EMITTING DIODE PACKAGE HAVING THE SAME

BACKGROUND

1. Technical Field

The disclosure generally relates to a lead frame and a light emitting diode package having the lead frame, wherein the light emitting diode package can have advantages of better heat dissipation and versatile electrical wiring.

2. Description of Related Art

A typical light emitting diode package includes a substrate, a first electrode and a second electrode arranged on the substrate, and plural light emitting chips mounted on the substrate and electrically connecting with the first and second electrodes.

However, in a typical light emitting diode (LED) package, only two electrodes are provided to supply electricity to the light emitting chips, such that, the plural light emitting chips can only be connected in parallel with a power source, which limits the connecting ways of the light emitting chips. Furthermore, the typical LED package has a limited heat dissipation area and accordingly a poor heat dissipation capability which adversely affects the useful life and reliability of the typical LED package.

What is needed, therefore, is a lead frame and a light emitting diode package having the lead frame which can overcome the above-described shortcomings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view of a lead frame in accordance with an exemplary embodiment of the present disclosure.

FIG. **2** is a bottom view of the lead frame of FIG. **1**.

FIG. **3** is a cross-sectional view of the lead frame of FIG. **1** with a reflecting cup thereon, taken along a line III-III thereof.

FIG. **4** is a cross-sectional view of the lead frame of FIG. **1** with a reflecting cup thereon, taken along a line IV-IV thereof.

FIG. **5** is a top view of a light emitting diode package having two light emitting chips electrically connecting with each other in series on the lead frame of FIG. **1**.

FIG. **6** is an equivalent circuit diagram of the light emitting diode package of FIG. **5**.

FIG. **7** is a top view of a light emitting diode package having two light emitting chips electrically connecting with each other in parallel on the lead frame of FIG. **1**.

FIG. **8** is an equivalent circuit diagram of the light emitting diode package of FIG. **7**.

FIG. **9** is a cross-sectional view of a light emitting diode package having a reflector and two light emitting chips connecting with each other in series on the lead frame of FIG. **1**.

FIG. **10** is a top view of a light emitting diode package having two light emitting chips connecting with each other in series and a zener diode connecting with one of the two light emitting chips in parallel on the lead frame of FIG. **1**.

FIG. **11** is a top view of a light emitting diode package having two light emitting chips connecting with each other in series and a zener diode connecting with the two serially-connected light emitting chips in parallel on the lead frame of FIG. **1**.

FIG. **12** is a top view of a light emitting diode package having two light emitting chips and a zener diode connecting with each other in parallel on a lead frame of FIG. **1**.

DETAILED DESCRIPTION

Exemplary embodiments of a lead frame and a light emitting diode package having the lead frame in accordance with

the present disclosure will now be described in detail below and with reference to the drawings.

Referring to FIGS. **1-2**, a lead frame **100** in accordance with an exemplary embodiment of the present disclosure is provided. The lead frame **100** includes a substrate **10**, a bonding electrode **20**, a first connecting electrode **21** and a second connecting electrode **22**. The bonding electrode **20**, the first connecting electrode **21** and the second connecting electrode **22** are spaced from each other.

The substrate **10** includes a flat top surface **101** and a flat bottom surface **102** opposite and parallel to the top surface **101**.

The bonding electrode **20**, the first connecting electrode **21** and the second connecting electrode **22** are embedded in the substrate **10**, and each have the same thickness with the substrate **10**. That is, top surfaces of the bonding electrode **20**, the first connecting electrode **21** and the second connecting electrodes **22**, are coplanar with and exposed out of the top surface **101** of the substrate **10**; and bottom surfaces of the bonding electrode **20**, the first connecting electrode **21** and the second connecting electrode **22**, are coplanar with and exposed out of the bottom surface **102** of the substrate **10**.

The bonding electrode **20** includes a first connecting portion **2041**, a second connecting portion **2042** and a main connecting portion **205** connecting the first and second connecting portions **2041**, **2042**.

The first and second connecting portions **2041**, **2042** are spaced from each other, and are paralleled to each other. The main connecting portion **205** is located between the first and second connecting portions **2041**, **2042**. Opposite ends of the main connecting portion **205** connects inner ends of the first and second connecting portions **2041**, **2042** respectively.

A width of the first connecting portion **2041** equals a width of the second connecting portion **2042**, and is larger than a width of the main connecting portion **205**. Such that, a recess **300** is defined among the first connecting portion **2041**, the second connecting portion **2042** and the main connecting portion **205**.

In this embodiment, the first and second connecting portions **2041**, **2042** are integrally formed with the main connecting portion **205** as a single piece.

The first connecting electrode **21** is located in the recess **300**, and is surrounded by the first connecting portion **2041**, the second connecting portion **2042** and the main connecting portion **205**. The first connecting electrode **21** is spaced from the first connecting portion **2041**, the second connecting portion **2042** and the main connecting portion **205**.

In this embodiment, the second connecting electrode **22** is located at a right side of the bonding electrode **20** along a longitudinal direction of the substrate **10**, and is spaced from the bonding electrode **20**. The bottom surface of the bonding electrode **20** occupies more than eighty percent of the entire area of the lead frame **100**. The bonding electrode **20**, the first connecting electrode **21** and the second connecting electrode **22** are made of metal materials with good thermal conductivity.

Referring to FIG. **4**, a cavity **203** is defined in a top end of the main connecting portion **205** of the bonding electrode **20** along a width direction of the bonding electrode **20**. The cavity **203** is recessed downwardly along a direction from a top surface of the bonding electrode **20** towards a bottom surface of the main connecting portion **205**. The cavity **203** does not penetrate through the bonding electrode **20** along a thickness direction. Preferably, a depth of the cavity **203** equals a half of the thickness of the bonding electrode **20**.

In this embodiment, the top surface of the bonding electrode **20** is divided by the cavity **203** to have a first bonding surface **201** and a second bonding surface **202**.

Referring to FIG. **3**, a groove **213** is defined through a top end of the first connecting electrode **21** along a transverse direction of the substrate **10**. The groove **213** is recessed downwardly along a direction from the top surface of the first connecting electrode **21** towards the bottom surface of the first connecting electrode **21**. The groove **213** does not penetrate through the first connecting electrode **21** along a thickness direction of the first connecting electrode **21**. Preferably, a depth of the groove **213** equals the depth of the cavity **203** in the bonding electrode **20**, a width of the groove **213** equals that of the cavity **203** in the bonding electrode **20**. In this embodiment, the cavity **203** is aligned with the groove **213** along the longitudinal direction of the substrate **10**.

Because of the groove **213**, the top surface of the first connecting electrode **21** is divided to have a first connecting surface **211** and a second connecting surface **212** located at opposite sides of the groove **213**.

A reflector **30** is located on the top surface **101** of the substrate **10**. The reflector **30** covers an outer periphery of the bonding electrode **20**, an outer periphery of the first connecting electrode **21** and an outer periphery of the second connecting electrode **22**.

The reflector **30** is made of polymeric materials, such as EMC (Epoxy Molding Compound) or SMC (Silicone Molding Compound).

In this embodiment, the reflector **30** includes a first receiving portion **301** and a second receiving portion **303** separated from the first receiving portion **301** by a dam **31**. The dam **31** is located at a central portion of the reflector **30**. The dam **31** extends along the transverse direction of the substrate **10**, and is over the cavity **203** and the groove **213**. A part of the substrate **10** fills in the cavity **203** and the groove **213**.

A width of the dam **31** gradually decreases from a bottom end on the substrate **10** towards a top end far away from the substrate **10**. The width of the bottom end of the dam **31** is larger than the width of the cavity **203**, but less than the width of the first connecting electrode **21** along the longitudinal direction of the substrate **10**.

The first bonding surface **201** of the bonding electrode **20** and the first connecting surface **211** of the first connecting electrode **21** are exposed at the bottom of the first receiving portion **301** of the reflector **30**; the second bonding surface **202** of the bonding electrode **20**, the second connecting surface **212** of the first connecting electrode **21**, and the top surface of the second connecting electrode **22** are exposed at the bottom of the second receiving portion **303** of the reflector **30**. In this embodiment, a height of the dam **31** is less than a height of the surrounding portion **305** the reflector **30**.

Alternatively, the reflector **30** is formed with the substrate **10** as a single piece and is made of a polymer material layer, wherein the reflector **30** and the substrate **10** are made of the same material.

Referring to FIGS. **5-6**, a first light emitting chip **41** is mounted on the first bonding surface **201**; a second light emitting chip **42** is mounted on the second bonding surface **202**. The first light emitting chip **41** electrically connects with the first bonding surface **201** and the first connecting surface **211** of the first connecting electrode **21** by two wires **40**, and the second light emitting chip **42** electrically connects with the second connecting surface **212** of the first connecting electrode **21** and the second connecting electrode **22** also by two wires **40**. Because the first bonding surface **201** and the second bonding surface **202** are connected by the bottom end of the bonding electrode **20**, and the first connecting surface **211** and the second connecting surface **212** are connected by the bottom end of the first connecting electrode **21**, the first light emitting chip **41** and the second light emitting chip **42** electrically connect with each other in series, as shown in FIG. **6**.

Referring to FIGS. **7-8**, the first light emitting chip **41** is mounted on the first bonding surface **201**; the second light emitting chip **42** is mounted on the second bonding surface **202**. The first light emitting chip **41** electrically connects with the first bonding surface **201** and the first connecting surface **211** of the first connecting electrode **21** by two wires **40**, the second light emitting chip **42** electrically connects with the second connecting surface **212** and the second bonding surface **202** by two wires **40**, and the second bonding surface **202** electrically connects the second connecting electrode **22** by a wire **40**.

Such that, the first light emitting chip **41** and the second light emitting chip **42** electrically connect with each other in parallel, as shown in FIG. **8**.

By the above disclosed configuration, because the first light emitting chip **41** and the second light emitting chip **42** can be electrically connected with each other on the lead frame **100** in series or in parallel, the electrical wiring between the first light emitting chip **41** and the second light emitting chip **42** is versatile.

Referring to FIG. **9**, an encapsulation layer **50** is formed to cover the first light emitting chip **41**, the second light emitting chip **42** and the dam **31** in the reflector **30**. The encapsulation layer **50** is made of transparent materials, such as epoxy resin, silicone. The encapsulation layer **50** can be doped with phosphor powders therein. In this embodiment, light emitted from the first light emitting chip **41** and light emitted from the second light emitting chip **42** can be mixed to obtain white light.

According to the present disclosure, because the bonding electrode **20** is made of metallic materials with good thermal conductivity and the bottom surface of the bonding electrode **20** occupies more than eighty percent of the entire area of the bottom surface of the lead frame **100**, heat generated from the first light emitting chip **41** and the second light emitting chip **42** can be rapidly conducted to the bottom surface of the lead frame **100** to dissipate, which increases the heat dissipating efficiency of the light emitting package.

Furthermore, because the reflector **30** and the substrate **10** are made of reflecting materials, such as EMC (Epoxy Molding Compound) or SMC (Silicone Molding Compound), the reflecting efficiency of the reflector **30** is increased. Accordingly, a light extraction efficiency of the light emitting package is increased.

Referring to FIG. **10**, when the first and second light emitting chips **41**, **42** electrically connect with each other in series, a zener diode **60** electrically connects with the bonding electrode **20** and the first connecting electrode **21**, such that the zener diode **60** electrically connects with the first light emitting chip **41** in parallel, which makes the electrostatic damage to the first light emitting chip **41** can be avoided. In this embodiment, the zener diode **60** is mounted on the top surface of the first bonding surface **201**, and electrically connects the first bonding surface **201** by a wire **40** and the first connecting surface **211** of the first connecting electrode **21** directly.

Alternatively, the zener diode **60** can be mounted on the second connecting surface **212**, or on the top surface of the substrate **10**.

Referring to FIG. **11**, the zener diode **60** can be mounted on the second connecting electrode **22**, and electrically connects the bonding electrode **20** by a wire **40** and the second connecting electrode **22** directly, which makes the zener **60** electrically connects with the serially-connected first and second light emitting chips **41**, **42** in parallel, whereby the electrostatic damage to the first and second light emitting chips **41**, **42** can be avoided by the zener **60**.

Referring to FIG. **12**, when the first and second light emitting chips **41**, **42** electrically connect with each other to the lead frame **100** in parallel, the zener diode **60** can be provided to electrically connect with the bonding electrode **20** and the first connecting electrode **21** respectively by two wires **40**, which makes the first light emitting chip **41**, the second light emitting chip **41** and the zener diode **60** electrically connects with each other in parallel on the lead frame **100**, whereby the electrostatic damage to the first and second light emitting chips **41**, **42** can be avoided by the zener **60**. In this embodiment, the zener diode **60** is mounted on the first connecting surface **211** of the first connecting electrode **21**.

It is to be understood that the above-described embodiment is intended to illustrate rather than limit the disclosure. Variations may be made to the embodiment without departing from the spirit of the disclosure as claimed. The above-described embodiments illustrate the scope of the disclosure but do not restrict the scope of the disclosure.

What is claimed is:

1. A lead frame for mounting at least a first light emitting chip and a second light emitting chip thereon, comprising:
- a substrate;
- a bonding electrode embedded in the substrate;
- a first connecting electrode embedded in the substrate; and
- a second connecting electrode embedded in the substrate, the bonding electrode, the first connecting electrode and the second connecting electrode being spaced from each other, a top surface of the bonding electrode comprising a first bonding surface and a second bonding surface spaced from the first bonding surface, the first connecting electrode comprising a first connecting surface and a second connecting surface spaced from the first connecting surface, top surfaces of the bonding electrode, the first connecting electrode and the second connecting electrode being exposed out of the substrate, the first bonding surface being configured for receiving the at least a first light emitting chip thereon and the second bonding surface being configured for receiving the at least a second light emitting chip thereon,
- wherein top surfaces of the bonding electrode, and the first and second connecting electrodes are coplanar with the top surface of the substrate.

2. The lead frame of claim **1**, wherein the at least a first light emitting chip is mounted on the first bonding surface of the bonding electrode, and is electrically connected with the first connecting electrode and the bonding electrode, and the at least a second light emitting chip is mounted on the second bonding surface of the bonding electrode, and is electrically connected with first connecting electrode and the second connecting electrode.

3. The lead frame of claim **2**, wherein the at least a first light emitting chip is mounted on the first bonding surface of the bonding electrode, and electrically connects with the first bonding surface of the bonding electrode and the first connecting surface of the first connecting electrode, and the at least a second light emitting chip is mounted on the second bonding surface of the bonding electrode, and electrically connects with the second connecting surface of the first connecting electrode and the top surface of the second connecting electrode.

4. The lead frame of claim **1**, wherein the at least a first light emitting chip is mounted on the first bonding surface of the bonding electrode, and electrically connects with the first bonding surface and one of the first and second connecting surfaces of the first connecting electrode, and the at least a second light emitting chip is mounted on the second bonding surface of the bonding electrode, and electrically connects with the second bonding surface and one of the first and second connecting surfaces of the first connecting electrode, and one of the first and second connecting surfaces of the first connecting electrode electrically connects with the second connecting electrode by a wire.

5. The lead frame of claim **1**, wherein bottom surfaces of the bonding electrode, and the first and second connecting electrodes are exposed out of the bottom surface of the substrate.

6. The lead frame of claim **5**, wherein the bottom surfaces of the bonding electrode, and the first and second connecting electrodes are coplanar with the bottom surface of the substrate.

7. The lead frame of claim **1**, wherein the first and second bonding surfaces of the bonding electrode are spaced by a cavity recessing downwardly from the top surface of the bonding electrode without penetrating through the bonding electrode along a thickness direction of the bonding electrode.

8. The lead frame of claim **7**, wherein a depth of the recess equals a half of the thickness of the bonding electrode.

9. The lead frame of claim **7**, wherein the first and second connecting surfaces of the first connecting electrode are spaced by a groove recessing downwardly from the top surface of the first connecting electrode without penetrating through the first connecting electrode along a thickness direction thereof.

10. The lead frame of claim **9**, wherein the cavity in the bonding electrode is aligned with the groove in the first connecting electrode, and a depth of the recess equals a depth of the groove, and a width of the recess equals a width of the groove.

11. A lead frame for mounting at least a first light emitting chip and a second light emitting chip thereon, comprising:
- a substrate;
- a bonding electrode embedded in the substrate;
- a first connecting electrode embedded in the substrate; and
- a second connecting electrode embedded in the substrate, the bonding electrode, the first connecting electrode and the second connecting electrode being spaced from each other, a top surface of the bonding electrode comprising a first bonding surface and a second bonding surface spaced from the first bonding surface, the first connecting electrode comprising a first connecting surface and a second connecting surface spaced from the first connecting surface, top surfaces of the bonding electrode, the first connecting electrode and the second connecting electrode being exposed out of the substrate, the first bonding surface being configured for receiving the at least a first light emitting chip thereon and the second bonding surface being configured for receiving the at least a second light emitting chip thereon, and
- wherein bottom surfaces of the bonding electrode, and the first and second connecting electrodes are exposed out of the bottom surface of the substrate.

12. A lead frame for mounting at least a first light emitting chip and a second light emitting chip thereon, comprising:
- a substrate;
- a bonding electrode embedded in the substrate;
- a first connecting electrode embedded in the substrate; and
- a second connecting electrode embedded in the substrate, the bonding electrode, the first connecting electrode and the second connecting electrode being spaced from each

other, a top surface of the bonding electrode comprising a first bonding surface and a second bonding surface spaced from the first bonding surface, the first connecting electrode comprising a first connecting surface and a second connecting surface spaced from the first connecting surface, top surfaces of the bonding electrode, the first connecting electrode and the second connecting electrode being exposed out of the substrate, the first bonding surface being configured for receiving the at least a first light emitting chip thereon and the second bonding surface being configured for receiving the at least a second light emitting chip thereon, and

wherein the first and second bonding surfaces of the bonding electrode are spaced by a cavity recessing downwardly from the top surface of the bonding electrode without penetrating through the bonding electrode along a thickness direction of the bonding electrode.

* * * * *